Ferroresonance

ABB s.r.o.

List of contents

- ***Resonance***
- Reasons of Ferroresonance
- Analyse
- Systems sensitive to ferroresonance
- Metods and tools for ferroresonance damping

Resonance

- Is common in every oscilating system

- Frekvency of influencing force is similar to resonance frekvency – resonance arise

$$\omega_r \ll \gg \frac{1}{\sqrt{LC}}$$

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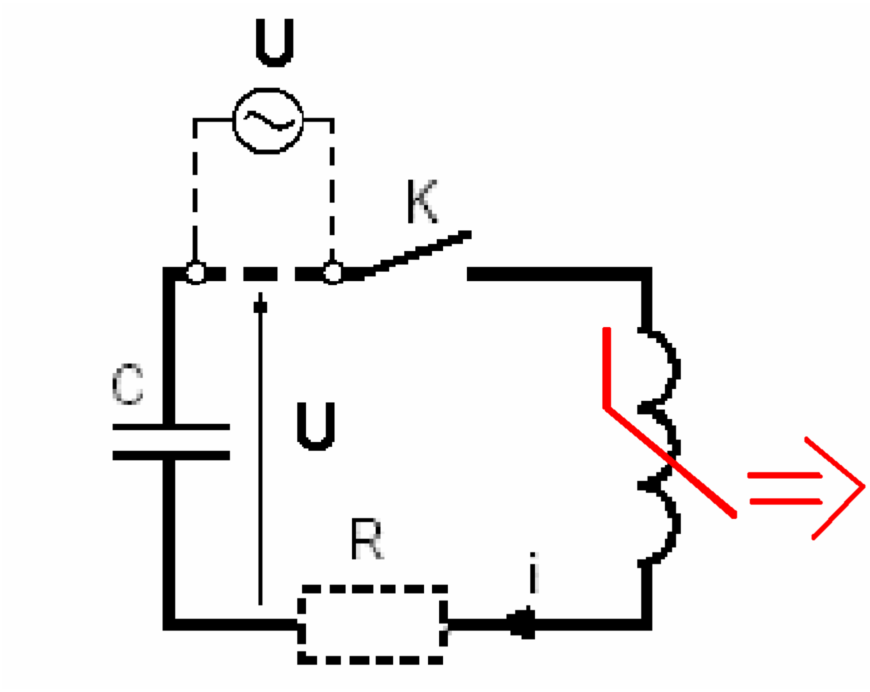
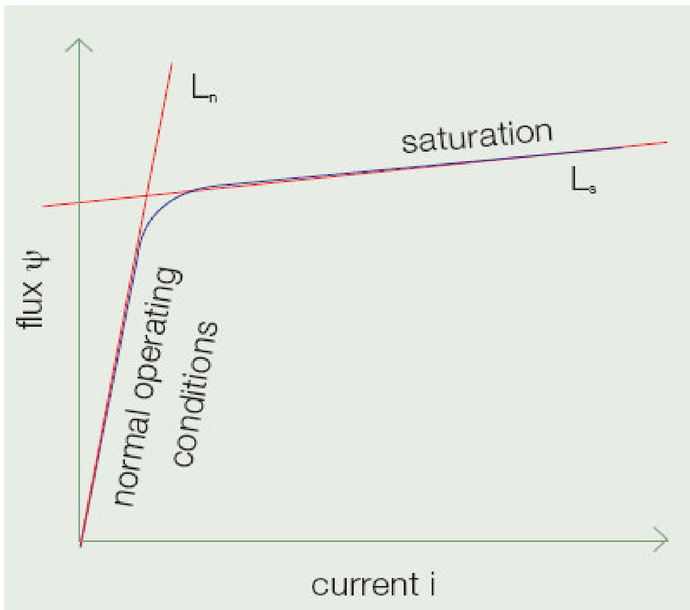
Ferroresonance

- Inductance with ferromagnetic core
- Inductance is not constant

L=f(i)





Ferroresonance – Reason

Resonance circuit

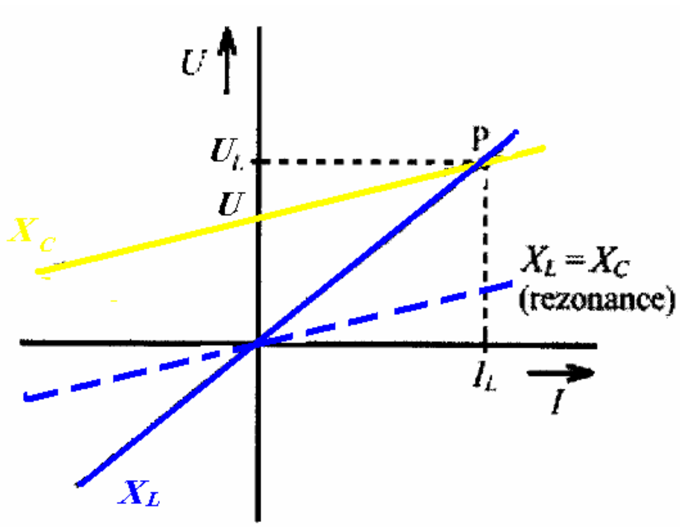
$$Z(\omega) = j\omega L - j\frac{1}{\omega C} + R_s$$

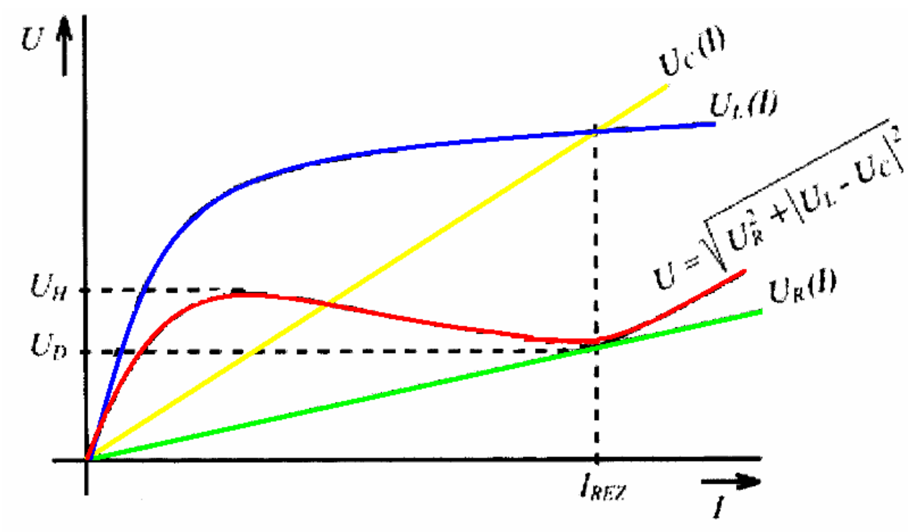
$$\omega_r = \frac{1}{\sqrt{LC}}$$

Ferroresonance circuit

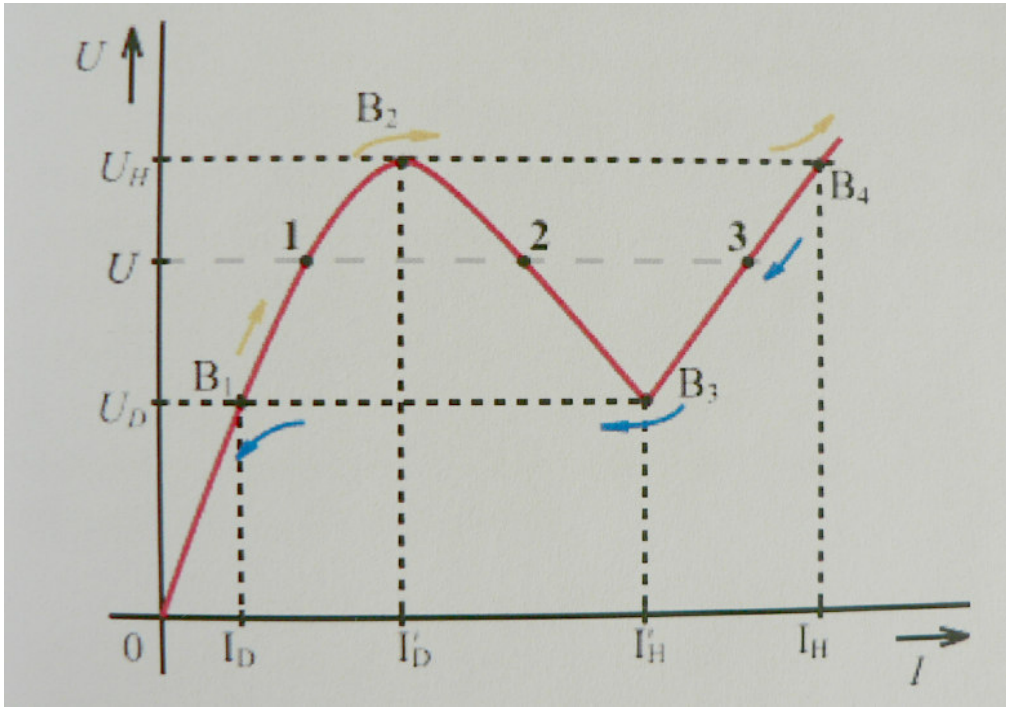
$$Z(\omega) = j\omega\,[\,f(i)\,] - j\frac{1}{\omega C} + R_s$$

$$\omega_{rF} = \frac{1}{\sqrt{[\,f(i)\,]\,C}}$$





Ferroresonance – Reason



- U in $U_H > U < U_D$, exist three operatings points - two stable “1,3“ and astable “2“
- If the system operate in point 2 then in little change of current the system jump to point 1 or 3.

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Ferroresonance – analyse

- Very complicated
- Mostly impossible to collect all parameters of systems and datas needed for accurate model.
- Models only simplified for typical cases
- Solutions only statistical solved probability of causes,or based on simply models that's why is not accurate.

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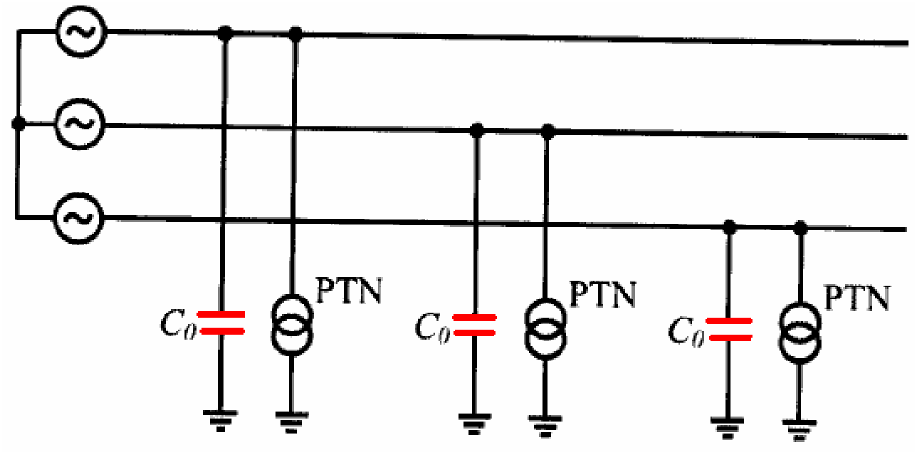
Systems sensitive to ferroresonance

- Voltage instrument transformer connected in nongrounded system

  Is major representative of MV



- Systems where new electronical relays were changed for electromechanical measuring equipment
- The VTs required with higher burden than it is necessary

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- ***Metods and tools for ferroresonance damping***

Methods and tools for damping of ferroresonance

- Principles of prevention

1. Careful project without configurations sensitive to ferroresonance.
2. Make sure, the parameters of system aren't in risk area. And if it's possible provide them some safety zone far away from this area.
3. Make sure, the power from supply isn't enough to hold ferroresonance. It can be provided by dumping

According to IEC 71-2 temporary ferroresonance overvoltage has to be damped.

Methods and tools for damping of ferroseronance

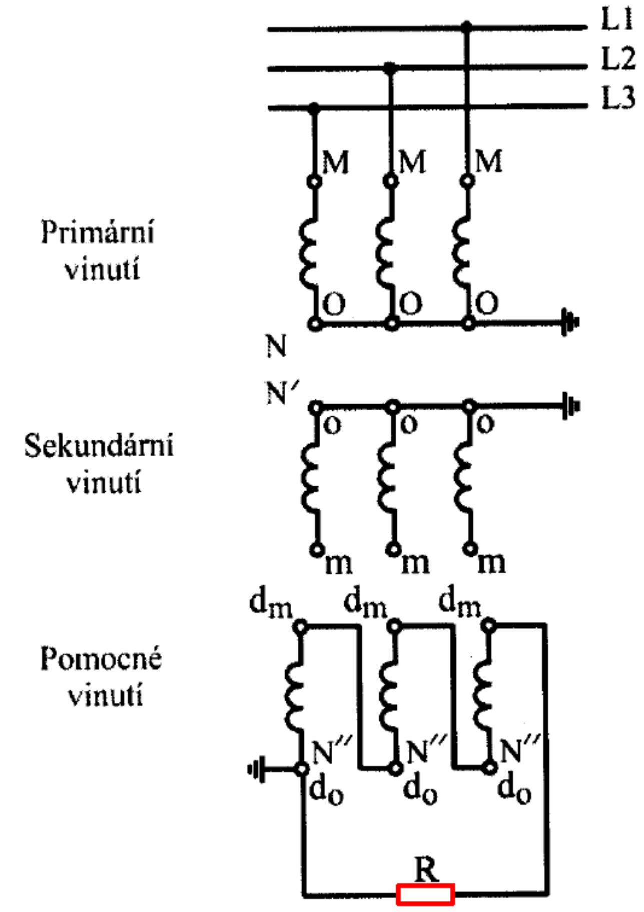
- Practical solutions

1. Instrument voltage transformers

- With two secondary windings

  First winding measuring second winding residual

  Damping resistor R is connected into one side of open delta.



Methods and tools for damping of ferroseronance

- Sensor

  2. Electronic instrument
     transformers – sensors.

  No ferromagnetic materials.

Conclusion

- Number of configurations in case of VTs, where can the ferroresonance arise, are nearly boundless.
- There can arise many types of ferroresonance oscillation .
- There are a lot of risk configurations.

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